Tampa Bay Integrated Science Pilot Study

Hydrographic and sub-surface mapping and sediment transport modeling

INTRODUCTION

Tampa Bay has been adversely impacted by human activity since the 1900's. Future environmental degradation may result from current plans to deepen and enlarge several ports, construction of a desalination plant, and terminus of an underwater gas pipeline from Alabama (Fig.1). The Bay has undergone severe shoreline erosion, habitat loss, seagrass and scallop dieoffs, and many other negative aspects. Over the next several years, this project will address water quality, transport of contaminants associated with sediments, and habitat loss issues. The aspect of water quality this project addresses is to identify locations of ground water seepage into the Bay. The mapping component of the Tampa Bay Pilot Study will apply seismic reflection profiling techniques and will coordinate with other project sub-tasks studying ground water issues. Investigations on transport of contaminants associated with sediments will apply numerical wave and circulation models to determine sediment transport gradients and pathways. Before these models can be accurately applied, bathymetry must be collected for the entire Bay. This project will collect bathymetry for the entire Bay using sonar and LIDAR techniques. There is an ongoing program to grossly map seafloor habitats with aerial photogrametric techniques; although, much of the Bay cannot be mapped due to high turbidity. This project will augment this ongoing program by providing sea floor characterization maps, especially in areas of high turbidity. New habitat mapping technology developed by the USGS will be applied in Tampa Bay. This new technology has the potential to identify sea grass species and density as well as surficial sediment type.

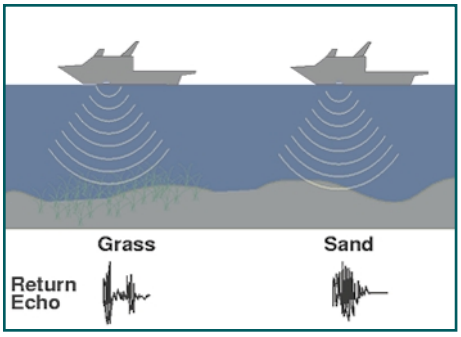

Figure 2. Classifying acoustic signal based upon return echo from depth sounder.

APPROACH

Benthic habitat mapping

- Develop a habitat mapping system with a level of sensitivity that can identify species and density of sea grass and broad range of sediment types.
- Verify results from various environments.
- Map limited areas to verify system.

Bathymetric mapping

- Map demonstration site areas to assess sea floor changes since the 1950's.
- Provide accurate data for numerical models.

Seismic surveying

- Demonstrate the importance of shallow seismic surveys to identify strata and structure, which may permit fresh water to seep into Tampa Bay.

Integration of wave and circulation numerical models

- Develop tools for model integration.

RESULTS/DISCUSSION

Benthic habitat mapping and numerical modeling:

Both of these efforts are currently under development. The benthic habitat mapping effort will provide a baseline for assessing future changes in benthic communities (Fig. 2). This effort will also directly address the location of the "deep" edges of sea grass beds. Numerical modeling of wave and circulation processes will help to address the physical mechanisms for observed changes of the benthic community. It is anticipated that these models will have predictive capabilities.

Bathymetric mapping:

The initial bathymetric mapping effort focused on the Palmetto quadrangle, which

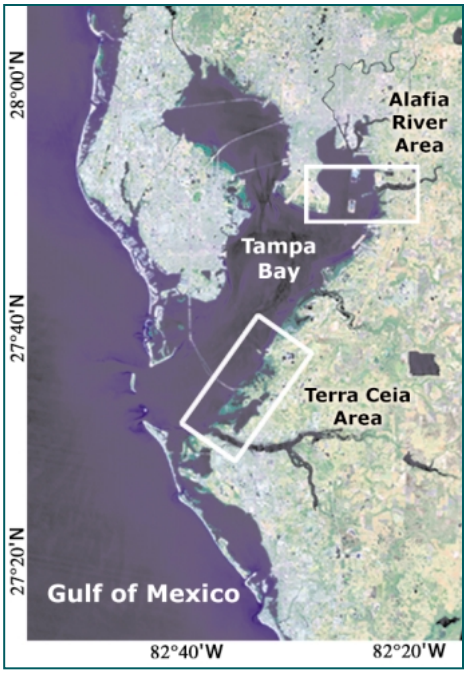

Figure 1. Satellite image of Tampa Bay indicating demonstration study sites near the Alafia River and Terra Ceia area. Colors are near natural; healthy plants are green, agricultural fields are pink or beige.

encompasses the Terra Ceia Aquatic Buffer Preserve (Fig. 3). A digital comparison of newly collected to the most recently collected (1950's) bathymetry data has not yet been made. However, a qualitative comparison to published nautical charts can be assessed. In general, water depths of the small bays and in the nearshore zone of Tampa Bay remain unchanged. The general shoreline shape and adjacent bathymetry of the area is generally cuspate in shape, reflecting the karst type topography of the region. The linear shape and bathymetry of Terra Ceia Bay and its orientation to the Manatee River suggests that this may have been at one time a tributary into the Manatee River; although, there is no present day evidence of a creek or river feeding into Terra Ceia Bay. Several uncharted linear channels in Miguel Bay, Joe Bay, Bishop Harbor are less than 0.5 m deep and appear to be either antecedent features or modern channels maintained by tidal currents. Linear bay bars are well defined north of the I-275 causeway and are less well pronounced south of the causeway. They are located approximately 1 km

Figure 3. Bathymetric contours draped over digit ortho photograph of the Terra Ceia Aquatic Buffer Preserve area.

from the shoreline with megaripple surficial expressions. The general water depth from the bars to the shoreline is approximately 0.5 m, with some areas exposed at low tide. Other studies suggest that bay bars protect sea grass beds from extreme wave conditions, and find a correlation between bay bar presence/morphology and sea grass health.

Seismic surveying:

Contamination from ground water sources is a major concern in Tampa Bay. Some estimates are that 20% of the fresh water input into Tampa Bay is from ground water sources; however, it is unknown where ground water seeps into the Bay. The hydrostatigraphy (rock layers and aquifers) of the Tampa Bay region consists of three variable and complex aquifer systems, two of which may be sources of ground water into Tampa Bay due to their proximity to the sea floor. The goal of the seismic surveying effort is to identify the location and depth of shallow aquifers beneath Tampa Bay. Seismic survey techniques use low frequency sound to identify sand and rock layers beneath the sea floor. For this pilot project, one seismic line was collected parallel to the I-275 Sunshine Skyway Bridge from Boca Ciega Bay to Joe Bay. One seismic line limits interpretation, yet this line reveals much information. Evidence of a significant sea level low stand and subsequent transgression may be revealed by a sharp contact approximately 20m below sea level (Fig. 4a). At this contact, there is a topographic high feature (identified by strong reflections) that may have been land during the low stand. Channel filling is evident at this contact which may be related to the antecedent bay and tidal processes. Folding of deeper strata is evident throughout the survey line, suggesting dissolution of older sediments has occurred deep beneath the bay (Fig. 4b). The survey line reveals two sinkhole like features that penetrate the contact (Fig. 4c). There is evidence of sediment filling in these depressions.

SUMMARY

- There are many small channels or cuts that do not appear on published bathymetric charts. The larger features appear to be related to nearby dredge and fill operations.
- Several uncharted linear channels in Miguel Bay, Joe Bay, Bishop Harbor are less than 0.5 m deep and appear to be either antecedent features or modern channels maintained by tidal currents.
- Linear bay bars are present along most of the shoreline in the Terra Ceia Aquatic Buffer Preserve, and are more contiguous north of the I-275 causeway.
- The underlying stratigraphy in Tampa Bay is not uniform.
- Subsurface features were identified which may allow ground water to leak upward from the superficial or intermediate aquifer systems.

LINKS TO OTHER TAMPA BAY RESEARCH

These investigations are directly linked to: classifying present day benthic environments, including sea grass density and extent; water quality issues and transport of contaminated sediments; and understanding the geological evolution and recent historical sediment accumulations of the bay. In summary, this research will help address three major issues in Tampa Bay: 1) status and health of sea grass beds, 2) freshwater water input and quality, and 3) transport and predictive modeling of contaminated sediments.

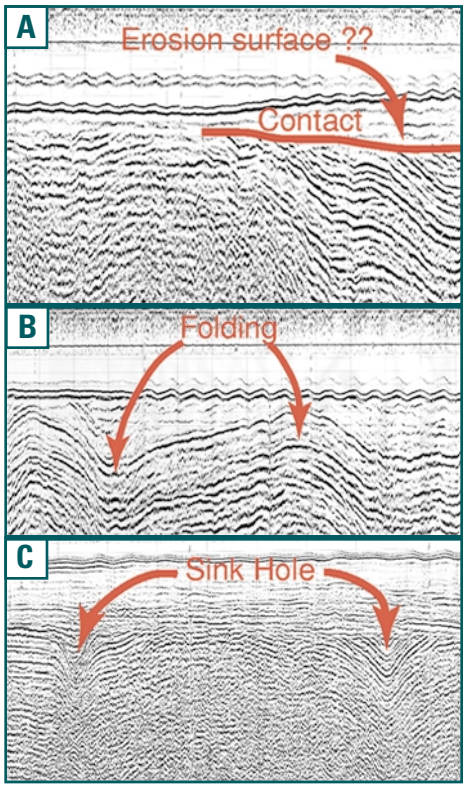

Figure 4. Seismic records showing sub-surface sand and rock layer features.

For more information, please contact:

Mark Hansen, Task Leader, Email: *mhansen@usgs.gov*
U.S. Geological Survey, Biological Resources Discipline
600 Fourth Street South, St. Petersburg, Florida 33701
Phone: 727-803-8747

Kimberly Yates, Scientific Project Leader, Email: *kyates@usgs.gov*
U.S. Geological Survey, Geological Discipline

http://gulfsci.usgs.gov

Contributing Scientists:

John Brock, USGS/Geological Discipline
Gregg Brooks, Eckerd College
Paul Carlson, FWC/Florida Marine Research Institute
Bill Carter, University of Florida
Gary Hill, USGS/Geological Discipline
Mark Luther, University of South Florida
Ramesh Shrestha, University of Florida
Wayne Wright, NASA